DOCUMENT RESUME

ED 465 507 SE 065 937

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TITLE Science Teacher Education in China: A Brief Examination of Science Teacher Supply, Demand, and Policies.
PUB DATE 2002-04-00
NOTE 8p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (New Orleans, LA, April 6-10, 2002).
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Educational Policy; Elementary Education; Foreign Countries; *Science Curriculum; *Science Instruction; *Teacher Education
IDENTIFIERS China

ABSTRACT

In response to the rapid development of science and technology and increasingly intensified world-wide economic competition, the Chinese central government is determined to improve basic education and has called for a full scale nation-wide education reform focusing on "quality education"--a paradigm shift from the traditional emphasis of student academic achievement and basic intellectual skills to the new focus of all-round development of children and improvement of the overall quality of citizenry for the 21st century. Whereas the vision of the reform described by the government requires changes throughout the entire education system, the success of all reform efforts will eventually depend on availability (or supply), quality, and determination of teachers. This paper examines the current state of teacher education systems in China and discusses interactions between science teacher supply and demand, teacher quality, and policies. (Contains 13 references.) (Author/MM)

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Science Teacher Education in China: A Brief Examination of Science Teacher Supply, Demand, and Policies

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Paper prepared for the 2002 Annual Conference of the National Association for Research in Science Teaching
New Orleans, LA
April 7-10, 2002

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Science Teacher Education in China: A Brief Examination of Science Teacher Supply, Demand, and Policies

In response to the rapid development of science and technology and increasingly intensified world-wide economic competition, the Chinese central government is determined to improve basic education and has called for a full scale nation-wide education reform focusing on "quality education" – a paradigm shift from the traditional emphasis of student academic achievement and basic intellectual skills to the new focus of all-round development of children and improvement of the overall quality of citizenry for the 21st century (1999). Whereas the vision of the reform described by the government requires changes throughout the entire education system, the success of all reform efforts will eventually depend on availability (or supply), quality and determination of teachers. In this paper, we will examine the current state of teacher education systems in China, and discuss interactions between science teacher supply and demand, teacher quality, and policies.

Current Status: Supply and Demand of the Teaching Force

Teacher education in China consists of two relatively independent components: pre-service education and in-service teacher professional development. Generally, four-year teachers colleges or normal universities provide pre-service education with a focus on secondary teacher preparation. In addition, they offer postgraduate programs and play an active role in in-service training for secondary school teachers. Two- or three-year teacher training colleges are responsible for pre-service teacher preparation at junior high school levels, while elementary teachers (K-6) are mainly trained at secondary level teacher training schools. Most recently, major cities including Beijing, Shanghai, and Tianjin, and some well-developed provinces such as Guangdong and Jiangsu have accomplished transformations from the traditional three-level pre-service teacher education system described above to a two-level system by eliminating and / or upgrading the existing secondary level teacher training schools.

In parallel, in-service teacher professional development programs designed for middle and elementary school teachers are usually provided by education colleges and in-service teacher training schools, respectively. Meanwhile, evening programs provided by universities, and distance learning such as correspondence education programs and satellite TV education programs, also play an important role in serving teachers' continuing education needs at all levels.

Over the past five decades since the founding of the People's Republic of China, there has been a remarkable improvement in teacher education. In 1949, there were only 12 teachers colleges or universities with 12,000 students majoring in secondary education, and 610 teacher training schools with 152,000 prospective elementary teachers (Department of Foreign Affairs of the State Education Commission of the P. R. C., 1995). By 2000, there were 221 normal universities and / or teachers colleges with 1,099,741 pre-service teachers in secondary education, and 683 secondary level teacher training schools with 769,796 elementary teacher trainees. There were also 138 education colleges and 2037 in-service teacher training schools that provided continuing professional development for about 493,000 in-service teachers at the K-8 levels (Ministry of Education of the People's Republic of China, Department of planning and development, 2000).

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In 1993, the Law on Teachers of the People's Republic of China was issued. According to the law, to be certified to teach at elementary levels, one has to finish an education program at a secondary teacher training school (or above). A certified junior high school teacher has to finish training at a 3-year teachers college (or above) and a senior high school teacher has to have a bachelor's degree or above. Table 1 below presents the number as well as education background of elementary and science teachers in general secondary schools (excluding secondary vocational and technical schools) in the year of 2000 (Ministry of Education of the People's Republic of China, Department of planning and development, 2000).

Table 1

Survey of Elementary Teachers and Science Teachers in General Secondary Schools (2000)

		# Teachers Graduated from 4-year Colleges / Universities	# Teachers Graduated from 2- or 3-year Colleges of Higher Education	# Teachers Graduated from Specialized Secondary Education	# Teachers Received General Secondary Education or Lower
Elementary School		**58,465** (1.0%)	**1,116,057** (19.0%)	**4,175,722** (71.3%)	**509,772** (8.7%)
Junior High School	Physics	**34,724** (14.4%)	**184,017** (76.6%)	**18,264** (7.6%)	**3,325** (1.4%)
	Chemistry	**25,554** (16.7%)	**115,498** (75.3%)	**10,294** (6.7%)	**2,053** (1.3%)
	Biology	**21,678** (17.4%)	**83,616** (67.0%)	**16,249** (13.0%)	**3,240** (2.6%)
	Geography	**17,740** (14.7%)	**81,955** (67.8%)	**17,187** (14.2%)	**3,931** (3.3%)
Senior High School	Physics	**59,410** (72.1%)	**22,435** (27.2%)	**376** (.4%)	**223** (.3%)
	Chemistry	**57,614** (73.0%)	**20,714** (26.3%)	**371** (.5%)	**188** (.2%)
	Biology	**20,519** (72.2%)	**7,664** (27.0%)	**172** (.6%)	**49** (.2%)
	Geography	**19,171** (69.2%)	**8,236** (29.7%)	**225** (.8%)	**78** (.3%)

In general, the demand for teaching force at secondary levels has always been significantly greater than the supply in the past decades in China. For instance, between 1997 and 2000, the annual demand of junior and senior high school teachers were estimated as 334,436 and 39,381, respectively. However, there were only 120,807 graduates from 3-year teachers colleges and 53,257 graduates from 4-year teachers colleges / normal universities in 1997. Among those graduated with a bachelor's degree, there were only 18,049 people who actually took teaching positions in senior high schools (Yuan, 2000). By considering factors such as school-aged population, class size, current teacher population, improved teacher certification requirement, and national goal of basic education, Shanghai Education Research Institute predicted that elementary

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schools would need 116,400 new graduates from 2-, 3- or 4- year colleges / universities each year between 2000 to 2008, whereas the secondary schools (including both general and vocational schools) would need 261,500 new teachers between 2001 and 2005, and 256,500 between 2006 and 2008, respectively (Table 2; Shanghai Education Research Institute, 2001). No reports were found on projection of future teacher supply by grade level or discipline.

Table 2

Annual Demand of New Elementary and Secondary School Teachers with Higher Education Background

Year	Elementary Teachers Needed Per Year	Junior High School Teachers Needed Per Year	Senior High School Teachers Needed Per Year	Graduates from 2-, 3- or 4-Year Teachers Colleges / Normal Universities
2000	116,400	124,500	82,000	193,100
2001-2005	116,400	124,500	137,000	
2006-2008	116,400	124,500	132,000	

Factors Influencing Science Teacher Supply and Demand

Science teacher supply in China is mainly controlled by both central and local governments and their policies. Every year, the governments decide an enrollment quota for each teacher training school, college and normal university primarily based on the capacity of each institution as well as national or local needs in basic education and development. Then teacher trainees will be either assigned or directed to different public schools upon graduation.

Currently China is in transition from planned economy to market economy. As a result, in addition to the general factors considered by the researchers at Shanghai Education Research Institute, many transitional factors are also playing important roles in influencing science teacher supply and demand. For instance, in the past decade, many classroom science teachers have left schools for higher pay jobs, pursuing graduate degrees within the country or going abroad.

At the senior high school level, a hidden factor influencing the demand for science teachers in individual schools is the national college entrance exams. Each school's implemented science curricula are practically determined by the content of subject matter required for the national exams. For instance, chemistry and physics have been heavily emphasized in secondary schools historically in China. Recently, in response to the national call for "quality education" as well as the reduction of students' stress or academic pressure, many provinces and cities have started to implement the so-called "3+X" model for the college entrance exams since 2000. The new model requires three core tests covering Chinese, mathematics, and foreign language, respectively, with one or more optional tests in the following disciplines: physics, chemistry, history, geography, politics, biology, the humanities, sciences-comprehensive, and a liberal arts-comprehensive (Li &

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Wang, 1999). As a result, there is now a surplus of physics and chemistry teachers in many high schools where the "3+X" model is adopted.

The current science education reform effort is another factor in determining the demand of science teachers at junior high schools and elementary levels (grades 3-6). According to the Guidelines for the National Basic Education Curriculum Reform (2001), schools and teachers are encouraged to teach sciences in an integrated approach at both elementary and junior high levels. With an emphasis of "scientific literacy for all," the recently released National Science Curriculum Standards (Grades 3-6, & 7-9), require students to not only know scientific knowledge, but also develop positive science attitudes and abilities for conducting scientific inquiry, problem-solving, and connecting science and technology with society (Ministry of Education of the People's Republic of China, 2001). The central government is currently sponsoring groups of science educators to develop and pilot integrated, innovative, inquiry-based science curriculum models in the nation. Therefore, there is an increasing need for developing a science teaching force with an integrated, inquiry-centered pedagogy.

Interactions Between Science Teacher Supply and Demand, Teacher Quality, and Policies

Public perception of the quality of the science teaching force is generally positive in China. In 1993, a survey research on the quality of Chinese compulsory education conducted by National Education Research Center and East China Normal University, reported that among the science teachers in six provinces, 93% were deemed as competent teachers whereas 7% were deemed as "less than satisfactory" (Xie & Tan, 1997). Usually, teachers' salary, merit pay, and promotion are based on the performance of the students. Many teachers have to work students hard by adding extra hours of teaching and problem-solving drills in order to improve their students' test scores in nation-wide or state-wide examinations, and therefore maintain their reputation as a good teacher.

To further improve both quality and quantity of national teaching force in general, the governments have adopted the following policies:

1) Improving teachers' social status and their living standards through raising salaries and providing attractive benefit packages. The Law on Teachers issued in 1993, stipulated that teachers' average salary should be equal to or above the average salary of those who work at governmental agencies.

2) Attracting more gifted students to teacher education programs through advance admission and other alternative routes with exemption of the National College Entrance Exams. Each year, certain number of excellent graduates from regular high schools or secondary level teachers training schools are recommended and directly admitted to higher teacher education institutions (Chen, 2000).

3) Inviting reputable non-teachers colleges / universities to contribute to the development of teaching force by offering teacher certification programs.

4) Developing provincial level key teachers universities within each province, municipality, and autonomous region. The key teachers universities or normal universities, are expected

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to model teaching and research, offer graduate level programs for both pre- and in-service teachers, work collaboratively with other local teachers institutions and governmental education agencies, towards the development of a coherent local teacher education system.

5) Transforming the traditional 3-level pre-service education system to the new 2-level system by gradually eliminating the secondary level teacher education programs. To increase cost-effectiveness and enhance connections between in-service and pre-service teacher education, in-service teacher training institutes are encouraged to merge with local pre-service teacher training colleges.

6) Strengthening and formalizing teachers' continuing education system. For instance, to assist the implementation of new science curriculum models, each teacher is required to receive formal training regarding the Guidelines for the National Basic Education Curriculum Reform, Science Curriculum Standards, the philosophy / content of the new curriculum and pedagogy. The Ministry of Education will soon issue Regulations on Continuing Education for secondary and elementary school teachers, through defining and / or specifying in-service training course contents, administration, infrastructure, examination and verification, awards and penalties (Ministry of Education of the People's Republic of China, 2002).

In the past two decades, Chinese governments at all levels have made significant progress in continuously improving teacher education as well as teachers' social status as a whole. Nowadays, teaching is becoming a more popular and respectful profession in China. Many graduates from non-teacher colleges / universities, are also starting to compete with those from normal universities or other teaching institutions for teaching positions. However, there are several pressing problems need to be solved in science teacher education. First, there is a great disparity in the quality and quantity of science teaching force between well-developed eastern China and under-developed western China. How to attract more qualified teachers to the less-developed regions of the country? And, how to retain the teachers there? … These questions are the challenges that policy makers are facing. Secondly, significant efforts should be made to change the current practice of implementing the exam-driven science curricula in high schools. On one hand, science teachers are always under a high pressure of producing high scores among the students in all high stake exams, which is a killer of both students' and teachers' creativities. On the other hand, due to the recent reform in college entrance exams, sciences become less important than those subjects listed in the three core tests. The status of science teachers within a school has dropped from the previous higher rank to a lower one, which negatively influenced the general attitudes of science teachers. Finally, more research data on the current status of science teachers, teacher quality, as well as science teacher education programs by each discipline should be collected and analyzed to provide a more accurate picture of teacher supply and demand – it will allow to make most efficient use of limited resources available and avoid unnecessary waste of time and effort.

In summary, demand for science teachers at secondary levels in China is generally greater than the supply. However, depending on the geographical regions, some schools have a surplus of science teachers in particular fields while there is an urgent need for teachers in all disciplines in less-developed areas. More research data are needed for guiding the development of effective

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policies and facilitating informed decision making. It is believed that science teacher education in China will be developed and enhanced steadily, by the joint efforts from the governments at all levels, higher teacher education institutions, continuing education institutes, and the society as a whole.

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